

**Response**

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Serial No.: 09/935,234

Confirmation No.: 9323

Filed: 22 August 2001

For: DILUTE CLEANING COMPOSITION AND METHOD FOR USING SAME

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**Remarks**

The Office Action of September 16, 2002, has been received and reviewed. With claim 67 having been amended, the pending claims remain claims 64-70. Reconsideration and withdrawal of the rejections, and entry and consideration of the new claim(s), are respectfully requested in view of the remarks presented herein.

**The 35 U.S.C. § 112, Second Paragraph, Rejection**

Claims 64-70 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. Specifically, the Office Action asserts that the claims recite "the broad recitation 'about', and [also recite] 'less than' which is the narrower statement of the range/limitation." The Office Action further states that "the phrase 'less than about' does not clearly address the boundaries and limits of the range. The term 'about' implies values both above and below the point. In direct contrast, the term 'less than' requires the value be below the point. It is unclear to the examiner if the applicant is claiming points above or below this specified value." Applicants traverse this rejection for at least the following reasons.

First, Applicants do not recite a claim limitation that includes the language "less than about." Rather, claims 64 and 67 recite "about x% by volume or less." This language, Applicants submit, clearly defines a range having a definite but flexible upper limit.

However, the Office Action alleges that the claim language includes a so-called broad/narrow limitation that is indefinite. In support, *Ex parte Wu*, 10 USPQ2d 2031 (Bd. Pat. App. & Inter., 1989) is cited. Applicants note, however, the decision in *Ex parte Wu*, like the other decisions cited in the Office Action, address the use of the term "such as" and other similar phrases that may raise a question as to whether the feature introduced by the language is merely exemplary or required. In *Ex parte Wu*, the court found no such doubt with the use of the term "optionally," likening its use to accepted claim language like "up to," "0 to ...%," and "not more than." Applicants submit that, like these accepted terms, no such indefiniteness exists with the claimed phrase "about x% by volume or less."

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Further, the M.P.E.P. makes clear that the term "about" is acceptable claim language (see e.g., M.P.E.P. §2173.05(b)(A), a range "between 25 to about 45%" was held to be clear in *Ex parte Eastwood*, 163 USPQ 316 (Bd. App. 1968)). The addition of the language "or less" does not render the claim indefinite as it merely reflects a range of values having an upper limit defined by the phrase "about x%."

Thus, contrary to the Office Action, the language "about x% by volume or less" in claims 64 and 67 does not render the claims indefinite. Accordingly, Applicants request reconsideration and withdrawal of the rejection.

**The 35 U.S.C. § 102 Rejections****Claims 64-70 (Oles (U.S. Patent No. 4,145,451))**

Claims 64-70 were rejected under 35 U.S.C. § 102(b) as being anticipated by Oles (U.S. Patent No. 4,145,451). In particular, the Office Action asserts that the transitional language "consisting essentially of" in claim 64 does not exclude the additional components taught by Oles. Applicants traverse.

Oles teaches a variety of chemical preservatives for foods. In each embodiment, the preservative includes acetic acid, phosphoric acid, and "moisture." However, the ranges provided for each example mathematically require additional components, i.e., no embodiment is identified as having acetic acid, phosphoric acid, and moisture components that add to 100%. As a result, additional food ingredients, e.g., oil, sweetner, egg yolk, salt, starch, gum, spice, must be included.

- **Claims 64-66**

The transitional phrase "consisting essentially of" limits the scope of a claim to the specified materials or steps "and those that do not materially affect the basic and novel characteristic(s)" of the claimed invention (see M.P.E.P. § 2111.03). The Board of Patent Appeals and Interferences' has stated that "[t]o determine the steps included versus excluded [where the transitional language 'consisting essentially of' is used,] the claim must be read in

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light of the specification" (MPEP § 2111.03 citing Ex Parte Hoffman, 12 USPQ2d 1061, 1063-64 (1989)).

The specification makes clear that Applicants intended to provide, at least in one embodiment, a cleaning composition consisting essentially of a dilute aqueous solution of phosphoric acid and acetic acid, wherein the phosphoric acid is of a concentration of about 5 % by volume or less and the acetic acid is of a concentration of about 30% by volume or less. It is further understood from the specification and the transitional language that other components that would materially alter the semiconductor cleaning capability of the claimed composition are to be excluded. Such other components would most certainly include those items that may negatively affect semiconductor fabrication (such as oil, gum and the other ingredients inherently included in the Oles preservatives).

If the Examiner believes that the specification of the present invention states or suggests such ingredients or components may be included in the claimed invention, Applicants request that the next Official Communication identify where in the specification such statement or suggestion is found. Applicants submit that, in lieu of any such statement or suggestion, Oles fails to recite each and every element of independent claim 64 as required for anticipation. As a result, reconsideration and withdrawal of the rejection are requested. Claims 65-66 are also submitted to be allowable both in view of their dependence and in view of the subject matter recited therein.

- Claims 67-70

Claim 67 recites a cleaning composition for use in semiconductor integrated circuit fabrication including phosphoric acid and acetic acid, wherein the composition includes phosphoric acid at a concentration of about X% by volume or less, where X is 5, and acetic acid at a concentration of about (100-X)% by volume or less, wherein the composition is operable to remove exposed metal from a surface at a removal rate of less than about 200 Å/minute.

Claim 67 does not recite the transitional language "consisting essentially of." It does, however, recite a composition that includes phosphoric acid (at a concentration of about X% by

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volume or less, where X is 5) and acetic acid (at a concentration of about (100-X)% by volume or less). Moreover, claim 67 has been amended to recite that the composition is operable to remove exposed metal from a surface at a removal rate of less than about 200 Å/minute. Support for this amendment is found in the specification as filed, see e.g., page 8, lines 7-14.

There is no teaching or suggestion identified in Oles of a composition having the claimed properties, e.g., no Oles composition is identified that is operable to remove material at the rate recited in claim 67.

As a result, Oles does not teach each and every element of claim 67 as required for anticipation. Reconsideration and withdrawal of the rejection of claim 67 are therefore requested. Claims 68-70 are also submitted to be allowable in view of their dependence and in view of the subject matter recited therein.

Claims 64-70 (Baker (U.S. Patent No. 5,508,229))

Claims 64-70 were also rejected under 35 U.S.C. § 102(b) as being anticipated by Baker (assumed to be U.S. Patent No. 5,508,229 although the Office Action cites U.S. Patent No. 4,145,451). Applicants traverse for at least the following reasons.

Baker is directed to a method of forming solder bumps on a semiconductor wafer. To that end, Baker specifies an etching solution of "1 to 25% phosphoric acid by volume, 1 to 10% acetic acid by volume, 0.1 to 2% hydrogen peroxide by volume, and the remaining balance 63 to 98% deionized (DI) water by volume," (col. 4, lines 55-61). Thus, Baker teaches only solutions having some concentration of hydrogen peroxide.

Applicants submit that the transitional language "consisting essentially of" in claim 64 excludes other components such as hydrogen peroxide, e.g., inclusion of such an ingredient would materially affect the basic characteristics of the claimed cleaning composition. Reconsideration and withdrawal of the rejection of claim 64 are therefore requested. Allowance of claims 65-66 are also requested not only due to their dependence on claim 64, but also because of the subject matter recited therein.

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Claim 67, on the other hand, recites, among other elements, a composition having a concentration of phosphoric acid of about X% or less, where X is 5. No teaching is identified in Baker of any composition having this concentration of phosphoric acid. Moreover, the composition of Baker et al. is not identified as having the removal rate recited in claim 67. For at least these reasons, claim 67 and the claims that depend therefrom (claims 68-70) are not anticipated by Baker. Reconsideration and withdrawal of the rejection are therefore requested.

**The 35 U.S.C. § 103(a) Rejections****Hitachi (JP 77048059) in view of Hwang et al. (U.S. Patent No. 4,681,657)**

Claims 64-70 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Hitachi (JP 77048059) in view of Hwang et al. (U.S. Patent No. 4,681,657). Applicants traverse.

Independent claim 64 recites a cleaning composition "consisting essentially of a dilute aqueous solution of phosphoric acid and acetic acid, wherein the phosphoric acid is of a concentration of about 5% by volume or less and the acetic acid is of a concentration of about 30% by volume or less."

Independent claim 67 recites "a cleaning composition for use in semiconductor integrated circuit fabrication comprising phosphoric acid and acetic acid, wherein the composition includes phosphoric acid at a concentration of about X% by volume or less, where X is 5, and acetic acid at a concentration of about (100-X)% by volume or less, and wherein the composition is operable to remove exposed metal from a surface at a removal rate of less than about 200 Å/minute.

Hitachi describes an etching process for etching aluminum layers. As a result, Hitachi utilizes an etchant including a high percentage of phosphoric acid, e.g., one composition includes 75cc phosphoric acid, 15cc acetic acid, and 5cc water.

Hwang et al. is also directed to an etchant for resistivity-specific etching of doped silicon films. The Office Action states that Hwang et al. supports "the obviousness of diluting etching compositions." It cites the following portion of the Hwang et al. specification:

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Initial attempts to produce a slower resistivity specific etch consisted of diluting the 1:3:8 HNA etch (Dash etch) with acetic acid while maintaining the molecular ratio of the oxidizing agent ( $\text{HNO}_3$ ) to the reducing agent (HF) at a constant value of 1.61 as in Dash etch. Whereas dilution did reduce the etch rate as expected, it also had undesirable side effects. The etchant was too preferential and failed to etch the higher doped polysilicon at the interface between the polysilicon layer and the underlying intrinsic or lightly doped surface. This resulted in a polysilicon residue remaining after etch. Not only was the etching non-uniform, the solutions were plagued by variable incubation periods before the onset of etching. This resulted in variation in the time required to remove polysilicon films of constant thickness. The result of these experiments is summarized in Table I.

*Hwang et al., column 5, lines 6-24.*

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to combine the references. Second, there must be a reasonable expectation of success. Finally, the prior art documents must teach or suggest all the claim limitations. See MPEP § 2143.

Applicants' submit that Hitachi and Hwang et al. fail to support a *prima facie* obviousness rejection of claims 64-70.

For example, independent claim 64 recites a cleaning composition consisting essentially of a dilute aqueous solution. . . Thus, to render claim 64 obvious, Hitachi in combination with Hwang et al. must teach a dilute aqueous solution as defined in the specification. "Dilute" refers to a "composition having about 35% reactive components or less by volume" (*Specification*, page 6, lines 26-27). In order to render claim 67 obvious, Hitachi in combination with Hwang et al. must also teach or suggest a cleaning composition of phosphoric acid at a concentration of about X% by volume or less, where X is 5, and acetic acid at a concentration of about (100-X)% by volume or less, wherein the composition is operable to remove exposed metal from a surface at a removal rate of less than about 200 Å/minute.

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- Claims 64-66

Hitachi clearly fails to teach or suggest the composition of claim 64. In fact, during the prosecution of the present application's parent, (App. Ser. No. 09/325,375), the Patent Office concluded that Hitachi "clearly [failed] to meet the applicant's limitation of a 'dilute composition.'" See the '375 Office Action dated 16 January 2001 (paper no. 7, page 2, paragraph 2). Moreover, even though directed to an anticipation rejection, the Office Action in the '375 case concluded that Hitachi failed "to provide motivation for the modification of the solution to meet the applicant's limitation to a 'dilute composition'" (emphasis added).

However, the present Office Action asserts that, when combined with the identified teachings of Hwang et al., "a chemist's first attempt at reducing etching rate would be the obvious choice of dilution." Applicants submit that Hwang et al., however, offers no motivation to dilute the composition of Hitachi, especially to anywhere near the concentrations of the claimed invention. Thus, the combination of Hwang et al. with Hitachi is insufficient to render claims 64-66 *prima facie* obvious.

Hitachi requires a high concentration of phosphoric acid to ensure adequate metal removal, e.g., it must *not be* "dilute" as defined and claimed in the present application, to achieve its desired etching effect.

The identified portions of Hwang et al., however, do not motivate one to dilute the compositions of Hitachi to the claimed levels. In fact, the cited portions of Hwang et al. illustrate various negative effects of diluting the 1:3:8 HNA etch with acetic acid (e.g., too preferential, failed to etch effectively, residue resulting).

This distinction is important as the present invention is *not* directed, as alleged, to a diluted etching composition but rather is directed to a *composition useful for cleaning in IC fabrication*. While variation in concentration of chemical compositions may be common, there is no suggestion identified in either Hitachi or Hwang et al. to dilute the Hitachi composition to anywhere approaching the claimed concentrations. i.e. there is no suggestion that such a diluted composition would be an effective etchant. Further, there is no suggestion identified in Hitachi or Hwang et al. that reducing the phosphoric acid component of Hitachi to the ranges claimed by

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Applicants would yield a composition useful for *cleaning* a surface rather than etching material therefrom. If anything, these documents suggest the opposite, i.e., much higher concentrations are advantageous as they are beneficial to the intended function of material removal.

Applicants further note that compositions having phosphoric acid in concentrations greater than that claimed (i.e., concentrations identified in Hitachi) may be detrimental to the function of the claimed cleaning composition. For example, the specification notes that "[if] the concentrations of the phosphoric acid component is increased above 5%, excess metal loss may undesirably result from the surface being cleaned" (see page 7, lines 17-18). Such material removal is contrary to the present invention but is essential to both Hitachi and Hwang et al.

Thus, the specification clearly indicates the detrimental effects of compositions which have high concentrations of phosphoric acid, e.g., those compositions described in Hitachi and Hwang et al. Yet no motivation is identified in Hwang et al. to dilute the phosphoric acid content of Hitachi to anywhere approaching the claimed concentrations.

For at least these reasons, the combination of Hitachi with Hwang et al. fails to support a *prima facie* obviousness rejection. Reconsideration and allowance of claim 64 are therefore requested. Reconsideration and allowance of dependent claims 65-66 are also requested as these claims are submitted to be nonobvious both in view of their dependence on claim 64 and further in view of the subject matter addressed therein.

- Claims 67-70

Hitachi clearly fails to teach a composition like that claimed in claim 67, e.g., the phosphoric concentration of Hitachi is very high to ensure adequate etching. Moreover, there is no suggestion identified in Hwang et al. to alter the phosphoric concentration of Hitachi to a level that would reduce its etching effectiveness. In fact, the identified portion of Hwang et al. suggests that diluting the etching component(s) adversely affected the composition in unintended ways. Moreover, nothing is identified in either Hitachi or Hwang et al. that teaches or even suggests the removal rate recited in claim 67.



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For at least these reasons, claims 67-70 are not rendered obvious by the combination of Hitachi and Hwang et al. Reconsideration and allowance are requested.

Petzow in view of Hwang et al.

Claims 64-70 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Petzow in view of Hwang et al.

Like Hitachi, Petzow teaches an etchant for etching materials where the etchant composition includes 10 ml of glacial acetic acid and 10 ml of phosphoric acid (i.e., 50%; 50%).

Applicants submit that the combination of Petzow in view of Hwang et al. fails to render the claims obvious for the same reasons discussed above with respect to the 35 U.S.C. § 103(a) rejection of claims 64-70 under Hitachi in view of Hwang et al. For example, Petzow requires a high concentration of phosphoric acid to ensure adequate metal removal. Nothing in Hwang et al. would suggest reducing the phosphoric acid content of Petzow to the claimed levels, e.g., Hwang et al. indicates concentration reduction adversely affects etching properties. Moreover, with respect to claim 67, no teaching is identified in either Petzow or Hwang et al. of the recited removal rate.

For at least these reasons, Applicants submit that the combination of Petzow and Hwang et al. fails to render the claimed invention obvious. Reconsideration and allowance are requested.

Koike et al. (U.S. Patent No. 4,256,520) in view of Hwang et al.

Claims 64-70 were rejected under 35 U.S.C. § 103 (a) as being unpatentable over Koike et al. (U.S. Patent No. 4,256,520) in view of Hwang et al.

Koike et al., teaches an etchant for removing gallium from a surface. The etchant includes high concentrations of phosphoric acid, acetic acid, and nitric acid. As the Office Action admits, Koike et al. does not teach the claimed concentrations nor does it teach a composition consisting of a dilute aqueous solution as recited in claim 64. Rather, Koike et al. has a high phosphoric acid content. Thus, for the same reasons discussed above with respect to

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the rejection over Hitachi in view of Hwang et al., *prima facie* obviousness is unsupported. Moreover, Koike et al. specifically includes nitric acid, a component excluded by the language of claim 64. Further, nothing is identified in Koike et al. or Hwang et al. that suggests either the phosphoric acid concentration or the claimed removal rate recited in claim 67. For at least these reasons, reconsideration and withdrawal of the rejection are requested.

Martin et al. (U.S. Patent No. 4,230,522) in view of Hwang et al.

Claims 64-70 were rejected under 35 U.S.C. § 103 (a) as being unpatentable over Martin et al. (assumed to be U.S. Patent No. 4,230,522) in view of Hwang et al.

Martin et al., teaches an etchant for removing thin films of aluminum, silicon, and aluminum-silicon-alloy on composite structures. The identified embodiment of the etchant includes a high concentration of phosphoric acid and also includes ammonium fluoride and nitric acid. As the Office Action admits, Martin et al. does not teach the claimed concentrations. For the same reasons discussed above with respect to the rejection over Hitachi in view of Hwang et al., *prima facie* obviousness is unsupported. Moreover, with respect to claim 64, the identified embodiment of Martin et al. specifically includes ammonium fluoride and nitric acid, components excluded by the language of the present claims. Further, with respect to claim 67, no teaching is identified of the phosphoric acid concentration or the recited removal rate. For at least these reasons, reconsideration and withdrawal of the rejection are requested.

**Double Patenting Rejection**

Claims 64-70 were rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-5 of U.S. Patent No. 6,384,001. Applicants defer the filing of a terminal disclaimer until otherwise allowable subject matter is indicated.

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It is submitted that the pending claims 64-70 are in condition for allowance and notification to that effect is requested. The Examiner is invited to contact Applicants' Representatives, at the below-listed telephone number, if it is believed that prosecution of this application may be assisted thereby.

Respectfully submitted for  
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By

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PATENT TRADEMARK OFFICE

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**CERTIFICATE UNDER 37 CFR §1.8:**

The undersigned hereby certifies that this paper is being transmitted by facsimile in accordance with 37 CFR §1.6(d) to the Patent and Trademark Office, addressed to Assistant Commissioner for Patents, Washington, D.C. 20231, on this 16<sup>th</sup> day of December, 2002, at 3:28pm (Central Time).

By:

  
Name: Sara E. Olson

## APPENDIX A - CLAIMS AMENDMENTS

Serial No.: 09/935,234

Docket No.: 150.00450122

Claim amendments are identified by underlining what has been added and bracketing what has been deleted.

64. A cleaning composition for use in semiconductor integrated circuit fabrication, the cleaning composition consisting essentially of a dilute aqueous solution of phosphoric acid and acetic acid, wherein the phosphoric acid is of a concentration of about 5% by volume or less and the acetic acid is of a concentration of about 30% by volume or less.

65. The cleaning composition of claim 64, wherein the phosphoric acid is of a concentration of about 5% or less by volume and the acetic acid of a concentration of about 10% or less by volume.

66. The cleaning composition of claim 64, wherein the phosphoric acid is of a concentration of about 5% or less by volume and the acetic acid is of a concentration in the range of about 20% by volume to about 30% by volume.

67. (AMENDED) A cleaning composition for use in semiconductor integrated circuit fabrication comprising phosphoric acid and acetic acid, wherein the composition includes phosphoric acid at a concentration of about X% by volume or less, where X is 5, and acetic acid at a concentration of about (100-X)% by volume or less, and wherein the composition is operable to remove exposed metal from a surface at a removal rate of less than about 200 Å/minute.

68. The cleaning composition of claim 67, wherein the composition is a dilute composition, wherein the dilute composition includes phosphoric acid at a concentration of about 5% by volume or less, acetic acid at a concentration of about 30% by volume or less, and deionized water.

**Amendment and Response - Appendix A**

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Applicant(s): Hineman et al.

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69. The cleaning composition of claim 68, wherein the dilute composition includes phosphoric acid at a concentration of about 5% by volume or less, acetic acid at a concentration of about 10% by volume or less, and deionized water.

70. The cleaning composition of claim 68, wherein the dilute composition includes phosphoric acid at a concentration of about 5% by volume or less, acetic acid at a concentration in the range of about 20% by volume to about 30% by volume, and deionized water.